PROJECT PROGRESS REPORT

PREPARED FOR THE ALASKA ENERGY AUTHORITY BY
THE ALASKA CENTER FOR ENERGY AND POWER

PROJECT TITLE: *Round 1:* Emerging Energy Technology Fund – Data Collection

REPORTING PERIOD: 2nd Quarter 2016

DATE OF REPORT: July 15, 2016

GRANT RECIPIENT:
Alaska Center for Energy and Power
University of Alaska Fairbanks
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Fairbanks AK 99775-5910

EETF Round 1 Projects

Project #003 – Alaska Division of Forestry, Biomass Reforestation

This project is complete, and a final report from the Division of Forestry is forthcoming.

Project #006 – Arctic Sun, Arctic Thermal Shutters and Doors

This project has reached completion. ACEP data analysis and final reporting is underway.

Project #009 – Genesis – Ultra-Efficient Generators and Diesel-Electric Propulsion

As discussed at the July 14, 2015 meeting with AEA Program Managers Alan Baldivieso and Josh Craft, this project will be concluded at its current stage of development. ACEP will communicate with AEA about appropriate final reporting activities.

Project #026 – Cold Climate Housing Research Center (CCHRC), Ground Source Heat Pump (GSHP)

The ground source heat pump at CCHRC continues to operate normally. However, it has operated very little since the last quarterly report due to the high summer temperatures in a Fairbanks summer, and very little new data is available. In the next quarterly report, the data should show the level of rebound of summer ground temperatures. This summer rebound of ground temperatures and the time it will take for the ground temperatures to equilibrate is a key question of this study.

Project #028 – University of Alaska Fairbanks (UAF), Organic Rankine Cycle (ORC)

ACEP awaits details of this project's extension from AEA and UAF.

Project #029 – University of Alaska Fairbanks, Exhaust Thimble

The thimble project is complete, and the ACEP final report is undergoing final review.

Project #035 – Altaeros, Airborne Wind Turbine

Project activities this quarter have been minimal. ACEP continues to monitor project status.

Project #037- Oceana, Hydrokinetics

The project has reached completion. ACEP's final EETF Hydrokinetics report is undergoing technical review.

Project #043 – Ocean Renewable Power Corporation (ORPC), Hydrokinetics

The project has reached completion. ACEP's final EETF Hydrokinetics report is undergoing technical review.

Project #045 – Hatch, Flywheel

ACEP has completed independent data analysis for this project. The ACEP final report has been completed and is undergoing final review.

Project #049 – Intelligent Energy Systems (IES), Self-Regulated Grid

ACEP has received no updates about this project.

Project #051 – Intelligent Energy Systems (IES), Wind-Diesel-Battery Hybrid System

No new data has been transmitted to ACEP. ACEP has contacted IES for updates.

Project #058 – Boschma Research Inc. (BRI), Hydrokinetics

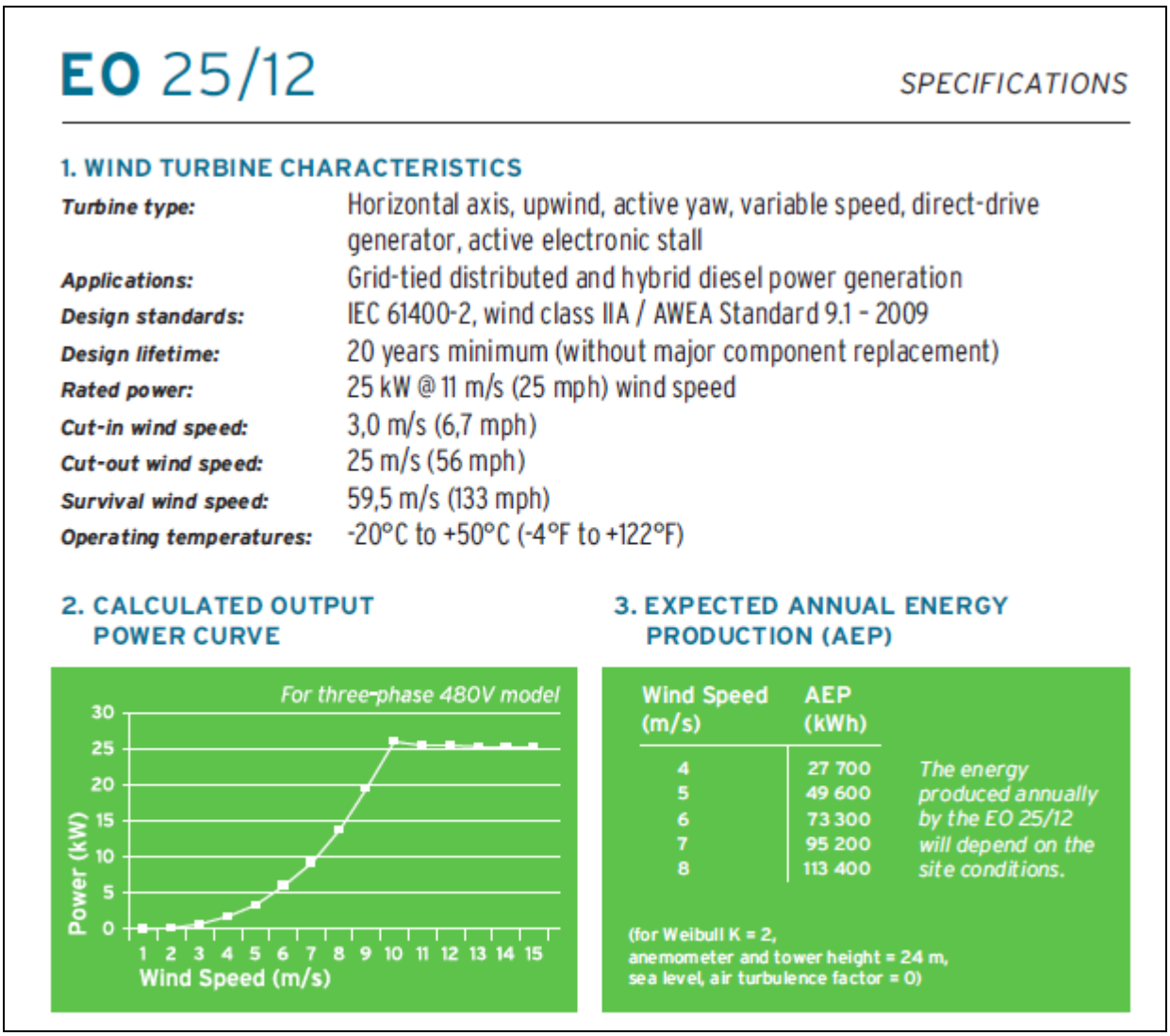
The project has reached completion. ACEP's final EETF Hydrokinetics report is undergoing technical review.

Project #061 – Marsh Creek, Various Speed Diesel-Electric Generation

ACEP has obtained a copy of Marsh Creek's final report, and data analysis is underway.

Additional Project – Northwest Arctic Borough, Arctic Field Testing and Power Curve Verification of Eocycle 25 kW Wind Turbine

The Eocycle 25 kW wind turbine in Kotzebue is currently operating, and ACEP has received the first month of produced data. The published specifications for the wind turbine are shown in Figure 1. The calculated power curve for the wind turbine projects the maximum power output of approximately 25 kW at wind speeds of approximately 10 meters/second.



EO 25/12 *SPECIFICATIONS*

1. WIND TURBINE CHARACTERISTICS

Turbine type:	Horizontal axis, upwind, active yaw, variable speed, direct-drive generator, active electronic stall
Applications:	Grid-tied distributed and hybrid diesel power generation
Design standards:	IEC 61400-2, wind class IIA / AWEA Standard 9.1 – 2009
Design lifetime:	20 years minimum (without major component replacement)
Rated power:	25 kW @ 11 m/s (25 mph) wind speed
Cut-in wind speed:	3,0 m/s (6,7 mph)
Cut-out wind speed:	25 m/s (56 mph)
Survival wind speed:	59,5 m/s (133 mph)
Operating temperatures:	-20°C to +50°C (-4°F to +122°F)

2. CALCULATED OUTPUT POWER CURVE

3. EXPECTED ANNUAL ENERGY PRODUCTION (AEP)

Wind Speed (m/s)	AEP (kWh)
4	27 700
5	49 600
6	73 300
7	95 200
8	113 400

The energy produced annually by the EO 25/12 will depend on the site conditions.

(for Weibull K = 2, anemometer and tower height = 24 m, sea level, air turbulence factor = 0)

Figure 1: Calculated power curve and expected annual energy production for Eocycle 25 kW wind turbine.

Five second data for the month of May have been submitted to ACEP for review. Power production and wind speed are shown in Figure 2, which is similar to the manufacturer's published power curve in Figure 1. One area of question occurs at the right side of the empirical power curve in Figure 2. There is very limited data in this region, and more data are needed in order to better analyze what is occurring, but the data appear to show that the wind turbine is being curtailed so that power production is lower than expected at high wind speeds.

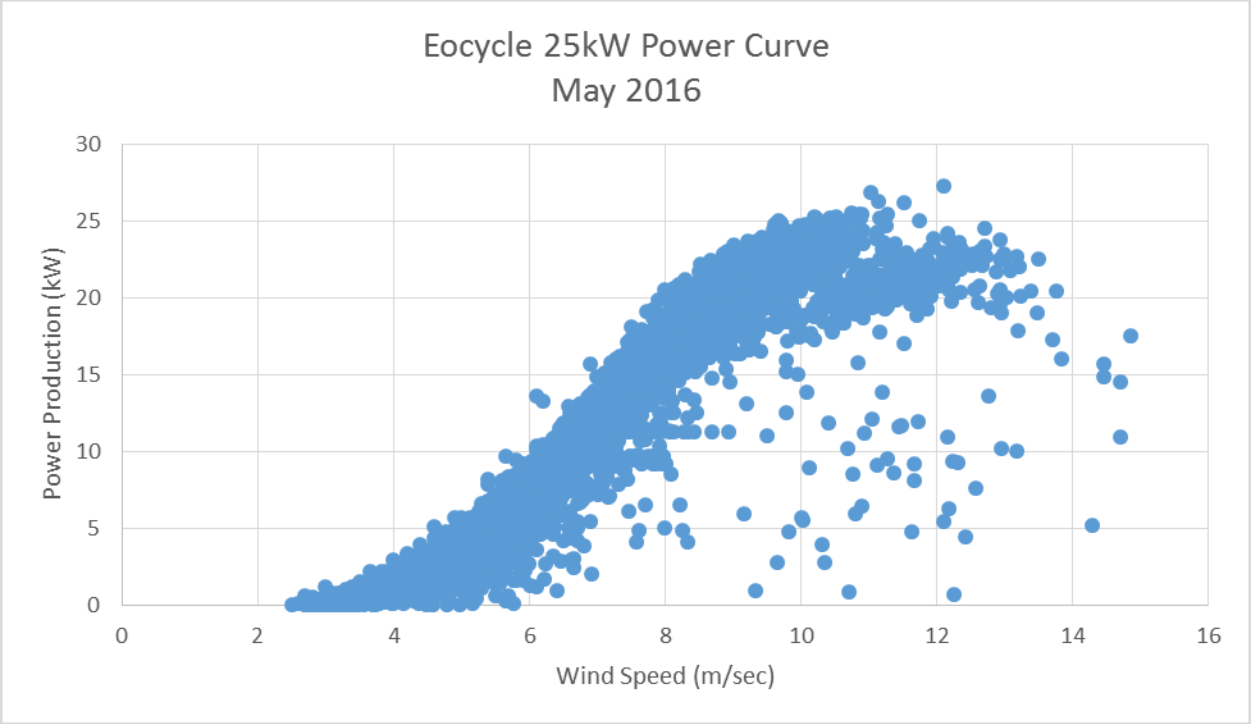


Figure 2: Eocycle 25 kW wind turbine power curve calculated from one month of data in May 2016.

The graph in Figure 3 below is similar to Figure 2. However, in Figure 3, the power production has been binned so that average power production is shown for each tenth of a meter per second. The resulting curve in Figure 3 is essentially the same as that of Figure 2 for wind speeds below 10 m/sec. Above this wind speed, however, there are fewer occurrences of power production. In addition, there is likely curtailing of the wind turbine so that less power is produced than the turbine's actual capacity. As the turbine continues to operate and produces more data, the data bins at the higher wind speeds in Figure 3 will be populated, and the power curve will likely be more consistent.

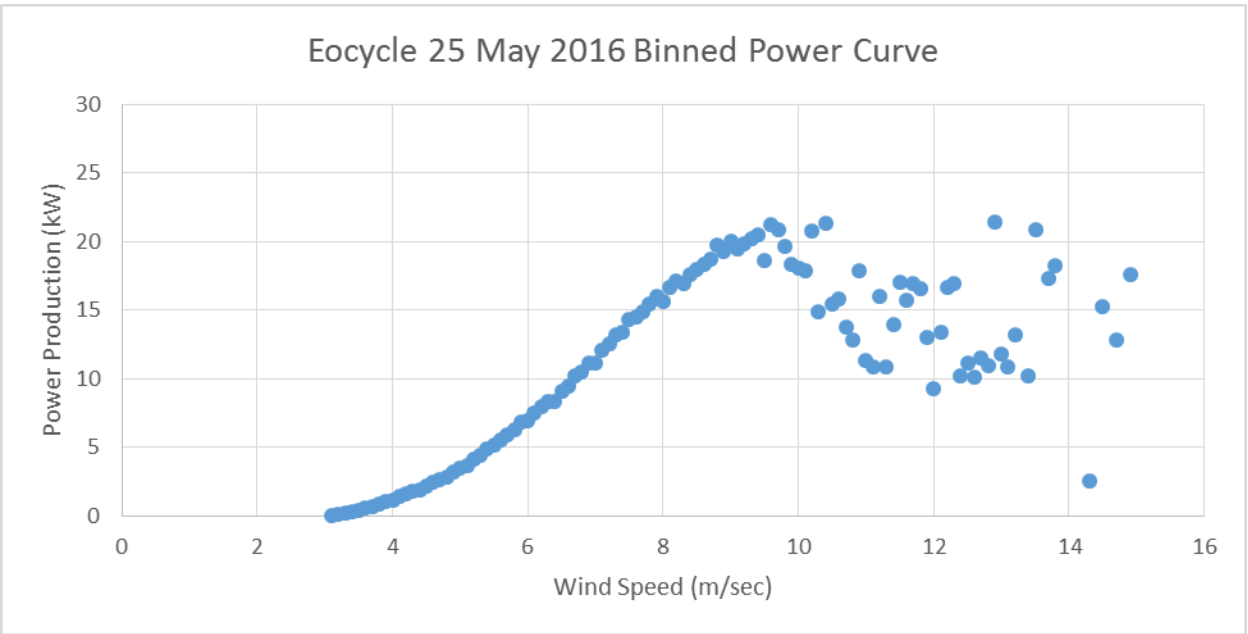


Figure 3: May 2016 binned power curve (averaged for each tenth of a meter per second) for Eocycle 25 kW wind turbine.